

III. *A plain and easy Experiment to confirm Sir Isaac Newton's Doctrine of the different Refrangibility of the Rays of Light. By the same.*

After the *Experimentum Crucis* made by two Prisms, I shou'd not give the following Experiment, but that it is so easy to be made, that by it those who want the *Apparatus* (or are unwilling to be at the pains) to make the *Experimentum Crucis*, may at any time satisfy themselves of the Truth of the fore-mention'd Doctrine.

Let the Candle *A* be set before the Bar of a Chimney Looking-Glaſs, such as is represented by *HH* (*Fig. 25*) which is a Piece of Looking-Glass Plate consisting of four Planes, seen in the Section of it $\alpha f d \beta$, viz. $d \beta$ which is quick-silver'd behind, $f \alpha$ a Plane parallel to it, $f d$ one of the Side-planes bezell'd towards $d \beta$, or inclin'd to it in an Angle of about 40 Degrees (tho' from 30 to 40 will do, but the greater the Angle the better, if it does not exceed 45°.) $\alpha \beta$ the other Side-Plane inclin'd in the same Angle to βd .

The Rays of the Candle which come from *A* to γ fall obliquely on the Plane $\alpha \beta$, so that instead of going on to α , they are by Refraction made to incline more towards the Perpendicular $p p$, namely to go on in the Line γc , and then are reflected from the Point *c* on the quick-silver'd Surface, in the Direction $c x$, so as to make the Angle $x c d = \gamma c \beta$. Now as the Rays which wou'd go to x , if not refracted, emerge obliquely from the Plane $\alpha \beta$, they leave the Direction $c x$, and decline from the Perpendicular $\pi \pi$, and, being differently refracted, open into four differently colour'd Rays; viz. *b R* a red Ray, *b T O* a Ray made

made up of Orange and Yellow ; $b\ G\ B$ a Ray made up of Green and Blue or a Sea-Green, and $b\ P$ a purple Ray.

If from the place $E\ e$ you look full upon the Point b , the *Spectrum* or Image of the Candle at b will appear double, but not mix'd ; that is, there will appear a Sea-green Spot and a red Spot, as it were, one upon another ; but not so as to produce a mix'd or intermediate Colour. Then if the right Eye or Eye at E be shut, there will appear only a green Spot to the Eye at e ; if the Eye at e be shut, the Eye at E will see only a red Spot.

If you come nearer to b , so that the Eyes at e_1 , e_2 receive the most and the least refrangible Rays, there will be a double *Spectrum*, viz. a red and a purple one just touching, or upon one another : and the Phænomenon will answer as before. (*Fig. 25.*).

If keeping both Eyes open, you direct their Axes towards O a Point nearer than the usual place of the compound *Spectrum S*, (*Fig. 26.*) which Point is in a Line from the Nose N to the Point S ; or in other Words, if you look full at O , or at the End of your Finger held in O , the red and the blue (or purple Spot) will appear to be divided from each other after the manner represented at $p\ r$ (*in Fig. 27*) where the Red will appear to be on the Right-hand, and the Blue on the Left.

To make plain what is meant by *seeing* the *Spectra p* and r whilst we look full at O , I beg leave to explain the Distinction between *looking* and *seeing* ; that I may the better shew how this Phænomenon proves that the Sensation of different Colours is caus'd by Rays differently refracted.

I. *Definition.*

The *Optic Axis* is a Line which going thro' the Center of the Convexity of all the Coats and Humours of the

A a a a

Eye

Eye, falls upon the Middle of the *Retina*, as *a a* or *A a*
Fig. 28.

II. *Definition.*

To look at any Point, is to turn both Eyes towards it in such manner, that the *Optic Axes* making an Angle at the said Point as *a*, the Rays from *a* may have the *Optic Axis* for their Axis, and (by their Convergence upon the *Retina* after Refraction in the *Eye*) may paint the Image of the said Point upon the Middle of the *Retina* of each Eye, where the *Optic Axis* in each Eye falls.

III. *Definition.*

To see without looking, is to direct the *Optic Axes* to some other place than to the Point which is then seen ; and in such a case, the Image of the Point seen will be projected upon a part of the *Retina* of each Eye, where the *Optic Axis* does not fall, namely either nearer to the Nose *N* as in (*Fig. 26.*) at the Points of the *Retina* mark'd *nn*; or farther from the Nose than the Middle of the *Retina*, as at *oo* in *Fig. 29.*

Whatever is seen, by being look'd at with both Eyes, always appears single, by reason of the Communication between the Middle of the *Retina* in one Eye, and the Middle of the *Retina* of the other : there being no such Communication between any other part of the *Retina* in one Eye, and the Correspondent part of the *Retina* in the other, when these correspondent parts are equally distant from the Nose.

There is indeed a Communication between the *Nervous Fibres* on the Right-side of the *Retina* of one Eye, and the nervous Fibres on the Right-side of the *Retina* of the other Eye, and so of those on the Left : but no single Object can be so painted in each Eye, as to have its Image on the Right or Left Part of one

one Retina that communicates with the Right or Left part of the other, of the same bigness and at the same time as in the other ; because in whatever Position the Object is, it must be nearer to one Eye than to the other, except it be just in a Line from the Nose betwixt the two Eyes streight forward.

Hence it is that if there be two Candles set before any one, the First at the Distance of one Foot, and the Second at the Distance of two Feet, from the Eyes ; he that looks at the second Candle at B will see it single, but see the first Candle or the Candle A double ; one Appearance being in the Line $AD\gamma$, the other in αAE , because it paints it self upon $\alpha\alpha$ in the Retina of each Eye, which Points are not the middle Points, but farther from the Nose than the middles mm .

So if B be the first Candle, and C the second, he that looks at B will see C double, because it is painted in the Retina at the Points nn nearer the Nose than mm ; and so will appear to be in the same Position as pr . in Fig. 27.

If $\gamma\rho$ be two Candles so disposed, Fig. 30. that by the Interposition of a perforated Board FF , γ can paint it self only in the Eye R , and ρ in the Eye L . Upon making the Optic Axes meet at B and to tend towards ρ and γ , ρ and γ will each paint an Image on the Middle of the Retina of each Eye, by crossing their Rays at B : and thus the two Candles will appear to be but One, or rather to be in one Place, upon the account of the Communication of the Middle of each Retina. But if instead of the Candles, ρ be a piece of red Silk, and γ a piece of green Silk, the same Position of the Eyes will make an Image at B , appearing like a red and green Spot together without a Mixture of the Colours. If ρ be a red hot Iron, and γ a Candle of Sulphur, the Phænomenon will be more distinct. If the Optic Axes be turn'd directly towards γ and ρ , as if there was no Board FF in the way, there will appear two

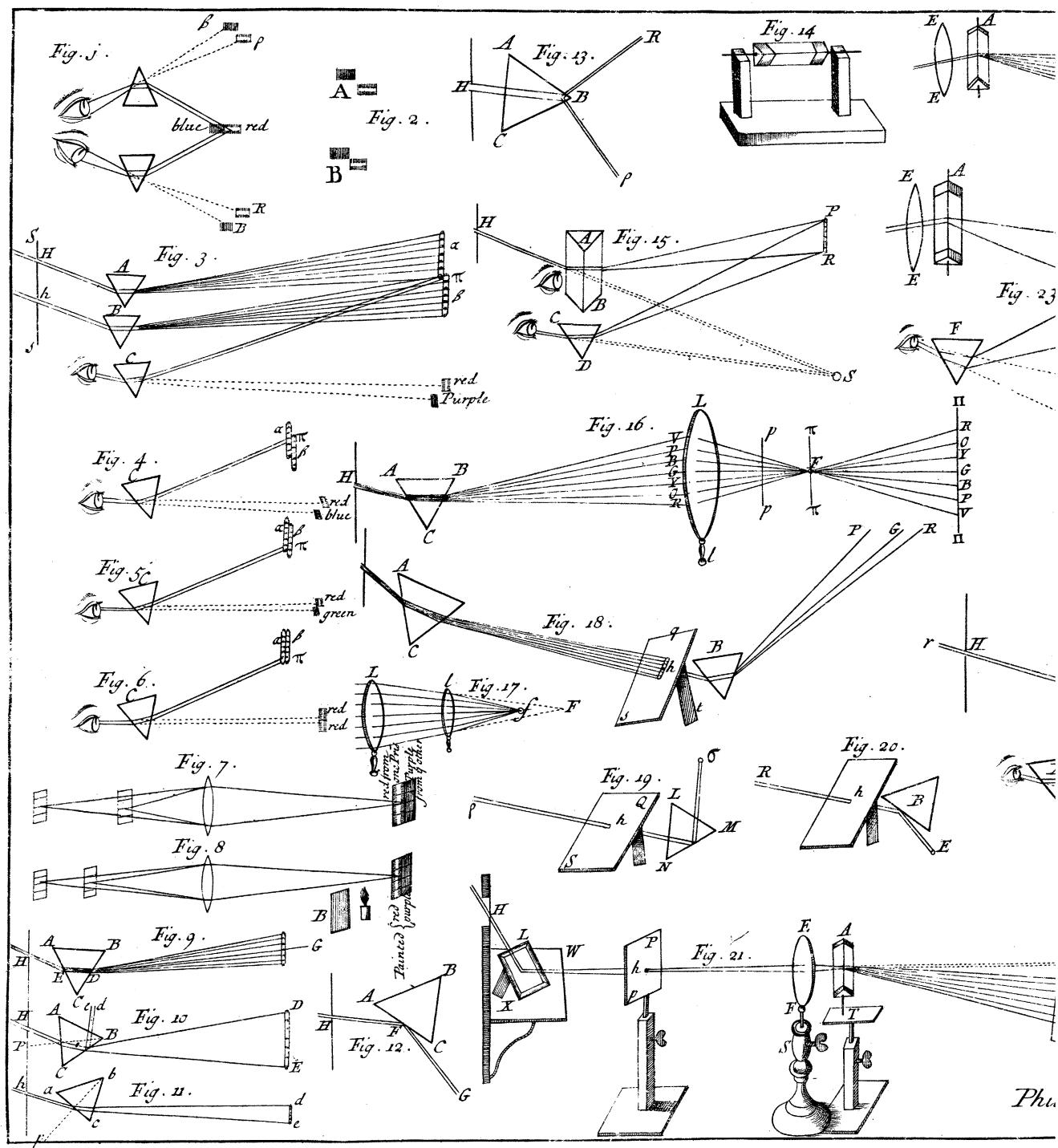
Holes in the Board, the one having the red hot Iron in it, the other the Candle.

Now if, of the refracted Rays of the Candle in the first Case (*Fig. 25.*) those which diverge from each other, so as to fall into each Eye, cause the same Sensations respectively, as the Rays which come from a red hot Iron and those which come from a blue Candle ; it is evident that the Candle in the first case affords red-making and blue-making Rays after Refraction, and that those Rays are differently refrangible ; the red *b R* (*Fig. 25.*) the least refrangible, as declining less from the Perpendicular *ww* ; and the Purple as *b P* declining most from the said Perpendicular.

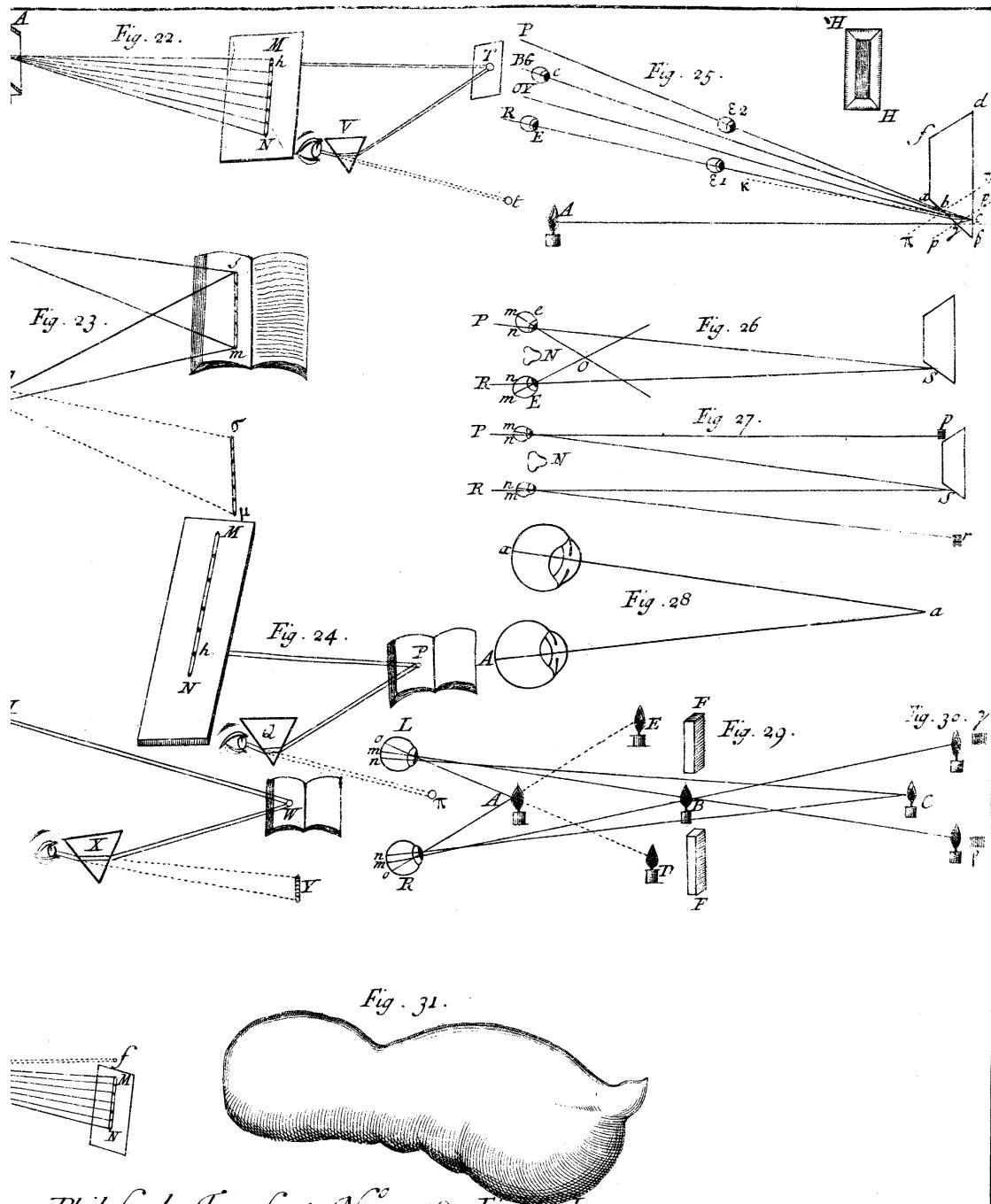
The same will (*ceteris paribus*) be found true in the intermediate Rays ; and to be certain that the Experiment is as I have related it, the Planes *af* and *fd* of the Barr may be covered with Paper.

IV. An Account of what appear'd on opening the big-belly'd Woman near Haman in Shropshire, who was suppos'd to have continued many Years with Child. Communicated by Dr. Hollings M.D. from Shrewsbury.

A Marry'd Woman, near *Haman* about Three Miles from *Shrewsbury*, about the 40th Year of her Age, had then first the common Reasons to believe she was with Child : at the Time of her Account she had the usual Signs of Labour, and a good Midwife, tho' mistaken, assur'd her it was so, but that the Child was so big she could not be delivered without bringing it away in pieces. She not submitting to that, her Pains were soon off, and she continued without any other Disorders Nine Months longer, when



Ph.



Philosoph. Transact. N^o. 348. Fig. I.

J. Senex Sculp^r